[12]. Miura *et al.* [8] recommended the use of i.v. carbapenems to treat multiresistant *E. coli* sepsis after transrectal prostate biopsy. They identified an increasing risk of fluoroquinolone resistance in patients with an obstructive lower urinary tract and who had a previous history of fluoroquinolone use. Feliciano *et al.* [7] found an overall incidence of infections after biopsy of 2.4%, and an overall incidence of fluoroquinolone-resistant infection of 1.2%. They identified an increasing trend for fluoroquinolone resistance in recent years, which may be related to the overuse of broad spectrum antibiotics.

After reviewing the current literature, we conclude that fluoroquinolones remain the most effective antimicrobial prophylaxis. Their effectiveness needs to be reassessed regularly in the face of emerging new resistance. Although resistance is increasing, the numbers do not warrant a complete change in antimicrobial policy; however, clinicians should be vigilant and have a low index of suspicion of fluoroquinolone-resistant microorganisms in patients presenting with infections after prostate biopsy. As time is of the essence in managing these patients, empirical treatment with aminoglycosides and either coamoxiclav or tazocin is indicated whilst awaiting cultures; however significant responses have been shown with carbapenems, such as meropenem, and these should be considered as an alternative [7].

CONFLICT OF INTEREST

None declared.

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SUPINE VS PRONE PERCUTANEOUS NEPHROLITHOTOMY: AN ANAESTHETIST'S VIEW

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INTRODUCTION

Prone positioning of the anaesthetized patient is necessary to allow optimal surgical access for many surgical specialties. Within urological surgery this includes percutaneous nephrolithotomy (PCNL) because the prone position is considered to afford the easiest approach to the kidney. However, two recent meta-analyses in the literature have shown that supine PCNL has a significantly shorter operating time than PCNL in the prone position and an equivalent stone-free rate, complication rate, transfusion rate and fever rate [1,2]. The authors concluded that PCNL in the supine position was as effective and safe as PCNL in the prone position and was an alternative option for removal of renal stones in PCNL [2]. Although not widely adopted in the UK, possibly because of fear of colonic injury and a lack of training in this position in educational centres [3], supine positioning of the patient for PCNL confers several anaesthetic advantages. The present comment paper aims to outline the potential problems with the prone position which may be taken into account when a centre is considering offering a supine PCNL service. If PCNL is to be performed prone then we believe an understanding by both surgeon and anaesthetist of the predictable physiological changes and the many complications that are associated with the prone position is essential for its safe use.

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IMPLICATIONS OF PRONE POSITIONING FOR ANAESTHESIA

LOCATION OF ANAESTHESIA

In many centres PCNL is performed in the radiology department. This is often a remote, isolated and unfamiliar environment to many anaesthetists. Anaesthetic equipment may be different from that used in theatre and anaesthetic help is not so readily at hand in case of emergency. Diabetes, obesity and spinal cord injury are all risk factors for stone formation thus patients undergoing PCNL often have multiple comorbidities, adding to the challenge. A patient anaesthetized in the supine position needs to be turned prone for the procedure and then turned supine again, once the procedure is completed, to be woken up. Anaesthetized patients are unable to protect themselves or assist during positioning so there is a risk of injury to both patient and staff. Safe positioning should involve a minimum of six people trained in the movement of patients into the prone position – one for the head, two each side and one controlling the feet and legs. Finding this number of trained personnel can be even harder in the radiology department than in the operating theatre and space is limited once the trolley, table and imaging equipment are in place. This all has time and cost implications for the operating list, specialty and hospital.

CARDIOVASCULAR IMPLICATIONS

Turning a patient prone has predictable effects on the cardiovascular system. The most consistent of these is a decrease in cardiac output. This has variously been attributed to reduced venous return, direct effects on arterial filling and reduced left ventricular compliance, secondary to an increase in thoracic pressure [4]. Obstruction of the inferior vena cava can also occur, exacerbated by abdominal compression, leading to decreased cardiac output, increased bleeding, venous stasis and the consequent potential thrombotic complications.

Should an unforeseen cardiovascular complication occur, then the insertion of invasive monitoring in the form of arterial lines, and particularly central venous catheters, although not impossible, is made much more difficult [5]. If cardiopulmonary resuscitation or defibrillation is required then the standard teaching is to turn the patient supine. This may obviously involve some delay. Prone defibrillation and CPR has been described but is not something that most clinicians are familiar with.

RESPIRATORY IMPLICATIONS

Functional residual capacity increases in the prone position and there is an alteration in the distribution of both ventilation and perfusion. Although there is some controversy, this is thought to lead to improved ventilation/perfusion matching and thus improved oxygenation [6,7], but this is only the case if the patient is carefully positioned to allow free movement of the abdomen which is not always easy to achieve.

AIRWAY

Intubation of the trachea with a reinforced endotracheal tube is the most widely accepted form of airway management in the prone patient. This must be very carefully secured as accidental extubation and loss of the airway in a ventilated prone patient is potentially disastrous. In such an event it may be possible to insert a laryngeal mask airway whilst prone, but it is likely that the patient will need to be rapidly turned supine to manage the airway and prevent hypoxia. Conversely, with increased neck flexion on turning prone the endotracheal tube may move down too far into the right main bronchus. If unrecognized, this leads to one-lung ventilation, increased airway pressures, lung collapse and hypoxia. Being in the prone position is more stimulating for the patient and this, combined with the need to be intubated and ventilated, requires a greater depth of anaesthesia. This in turn carries greater risks of cardiovascular compromise and can result in slower emergence and recovery.

PERIPHERAL NERVOUS SYSTEM INJURIES

Injury to the peripheral nervous system may occur because of abnormal and prolonged traction on an individual nerve or plexus or because of direct pressure on the nerve itself. The pattern of nerve injuries is different in the prone patient. Brachial plexus, ulnar, radial, lateral cutaneous nerve of the thigh and supraorbital nerve injuries have all been described [4]. Patients at higher risk are those with diabetes, peripheral vascular disease, alcohol dependency, pre-existing neuropathy and anatomical variants [8]. It would seem sensible to question patients about these risk factors before surgery and to warn them that, despite all measures taken to prevent nerve injury under anaesthesia, they are still at increased risk.

OCULAR DAMAGE

Corneal abrasions can occur if the eyes are not adequately taped and protected. Incorrect positioning, resulting in the weight of the head being supported on the globe, can lead to ischaemia and globe injury. This may be compounded by decreased perfusion pressure.

DIRECT PRESSURE INJURIES

Dependent areas are particularly at risk, including the forehead, nose, chest, arms, breasts, genitalia, pelvis, knees and feet. During long procedures, pressure sores could develop. It is essential to check that the patient is not lying on any monitoring leads or i.v. lines, as these can also lead to areas of pressure necrosis. Increased abdominal pressure and compression of abdominal viscera must be avoided. There are case reports of hepatic ischaemia and fatal hepatic failure after prolonged procedures in the prone position [9–11]. This complication might be more common than published reports would suggest and was investigated by the National Safety Patient Agency in 2006.

EQUIPMENT AND COST IMPLICATIONS

Extra equipment, in the form of specialized padding such as a 'Montreal' mattress or similar may be required to allow abdominal movement during prone ventilation [12]. Reinforced endotracheal tubes and extra monitoring, such as invasive arterial pressure monitoring, all cost more than 'standard' equipment. Turning the patient prone prolongs the duration of the operation which has implications for the number of operations that can be performed on a given operating list. Extra staffing costs may also be incurred because of the number of people needed to safely turn a patient into the prone position.

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CONCLUSIONS

Supine PCNL, although not widely adopted in the UK, has been shown to be as effective and safe as prone PCNL. As we have described, there are considerable clinical and cost implications of prone positioning which merit consideration in deciding what policy to adopt. It would seem of benefit for a centre to be able to offer supine PCNL to a selected group of patients who, because of their comorbidities, are at increased risk of complications from the prone position.

CONFLICT OF INTEREST

None declared.

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Abbreviation: **PCNL**, percutaneous nephrolithotomy.

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